Claims

[1] A digital DC-DC converter using digital modulation, comprising:
a PWM generator for converting an input DC voltage to a DC voltage of a preset level according to an input PWM signal;
a conversion portion for converting the DC voltage output from the PWM generator to a voltage of a preset level;
a delta-sigma modulator for converting a feedback voltage Vfd corresponding to the output voltage of the conversion portion to a 1-bit digital voltage according to a preset reference voltage;
a counter for counting logic 1's included in 1-bit digital voltage signals output from the delta-sigma modulator on a predetermined bit-unit basis; and
a delay controller for controlling a high-level delay time according to the number of logic 1's counted by the counter, and transferring a PWM signal having the controlled high-level delay time to the PWM generator.

[2] The converter as set forth in claim 1, wherein the delta-sigma modulator comprises:
a switched capacitor portion for performing switching according to first and second non-overlapping clock signals having two phases, so as to sample each of the feedback voltage and an output voltage of the D/A converter;
an integrator for integrating each of the voltages sampled by the switched capacitor portion;
a comparator for comparing a voltage output from the integrator with the preset reference voltage, and outputting a 1-bit digital voltage having a logic state "1" or "0"; and
a D/A converter for converting the digital voltage output from the comparator to a preset analog voltage according to the logic state of the digital voltage output from the comparator, and transferring the preset analog voltage to the switched capacitor portion.

[3] The converter as set forth in claim 2, wherein the switched capacitor portion comprises:
a first switch turned on/off according to the first clock signal to selectively connect the capacitor with an input terminal of the switched capacitor portion, the feedback voltage being received through the input terminal;
a second switch connected with the first switch via the capacitor, the second switch being turned on/off according to the first clock signal to selectively connect the capacitor with the reference voltage;
a third switch turned on/off according to the second clock signal to selectively

connect a connection node between the first switch and the capacitor with the output of the D/A converter; and

a fourth switch turned on/off according to the second clock signal to selectively connect the capacitor with an output terminal of the switched capacitor portion, the output terminal being connected with the integrator.

[4] The converter as set forth in claim 2, wherein if the digital voltage output from the comparator has a logic state "1", the D/A converter converts the output digital voltage to a preset negative analog voltage, and transfers the preset negative analog voltage to the switched capacitor portion, and if the digital voltage output from the comparator has a logic state "0", the D/A converter converts the output digital voltage to a preset positive analog voltage, and transfers the preset positive analog voltage to the switched capacitor portion.